

Amendment to the Claims:

Please amend the claims as follows:

Please cancel claims 2-25, 28-34, 38, 44-45, 47, 54-56, 60, 69-73, 75-76, 78-79, 81-83, 85, 87-89, 91-92, 94-95, and 98, without prejudice or disclaimer.

This listing of claims will replace all prior versions, and listing, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): A composition ~~chimeric polypeptide~~ comprising

(a) at least a first domain comprising a cannulae polypeptide and at least one additional ~~a second~~ domain comprising a non-cannulae ~~heterologous~~ polypeptide or peptide, a carbohydrate, a small molecule, a nucleic acid or a lipid;

(b) the composition of (a), wherein the non-cannulae polypeptide or peptide is inserted at the amino terminal end, the carboxy terminal end or internal to the cannulae polypeptide;

(c) the composition of (a) or (b), wherein the cannulae polypeptide comprises a protein having at least about 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, 60%, 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, 70%, 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% sequence identity to SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10 or SEQ ID NO:12;

(d) the composition of any of (a) to (c), wherein the cannulae polypeptide is capable of assembling into a polymer;

(e) the composition of any of (a) to (d), wherein the cannulae polypeptide is a recombinant or synthetic polypeptide, or the at least one additional domain comprises a polypeptide or peptide and the cannulae polypeptide and the polypeptide or peptide of the additional domain is a recombinant or synthetic polypeptide;

(f) the composition of any of (a) to (e), wherein the polymer acts as a biosynthetic pathway or a selection scaffolding;

(g) the composition of any of (a) to (f), wherein the composition is capable of acting as a chiral selector;

(h) the composition of any of (a) to (g), wherein the cannulae polypeptide comprises a protein having sequence as set forth in SEQ ID NO:2 SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10 or SEQ ID NO:12;

(i) the composition of any of (a) to (h), wherein the cannulae polypeptide comprises a FtsZ domain;

(j) the composition of any of (d) to (i), wherein the cannulae polypeptide is capable of assembling into a structure having an interior space;

(k) the composition of (j), wherein the structure having an interior space comprises a tubule or a nanotubule;

(l) the composition of (j), wherein the at least one additional domain is exposed into the inner lumen of the tubule or nanotubule;

(m) the composition of any of (d) to (i), wherein the at least one additional domain is expressed on the exterior of the tubule or nanotubule;

(n) the composition of any of (a) to (f), wherein the at least one additional domain comprises a chiral selection motif;

(o) the composition of any of (a) to (f), wherein the at least one additional domain comprises a receptor, a binding protein or a ligand;

(p) the composition of (o), wherein the binding protein comprises biotin;

(q) the composition of any of (a) to (p), wherein the non-cannulae polypeptide or peptide, or the at least one additional domain, comprises an enzyme;

(r) the composition of any of (a) to (f), wherein the non-cannulae polypeptide or peptide, or the at least one additional domain, comprises an enzyme active site;

(s) the composition of any of (a) to (f), wherein the non-cannulae polypeptide or peptide, or the at least one additional domain, comprises an antigen or an antigen binding site;

(t) the composition of any of (a) to (f), wherein the non-cannulae polypeptide or peptide, or the at least one additional domain, comprises a green fluorescent protein, an alpha-galactosidase or a chloramphenicol acetyltransferase;

(u) the composition of any of (a) to (f), wherein the non-cannulae polypeptide or peptide, or the at least one additional domain, comprises a recombinant or synthetic protein;

(v) the composition of any of (a) to (u), wherein at least one subsequence of the cannulae polypeptide has been removed;

(w) the composition of (v), wherein the non-cannulae polypeptide is inserted into the cannulae polypeptide at the site the subsequence was removed;

(x) the composition of (w), wherein the cannulae polypeptide is a CanA polypeptide and the removed subsequence is a 14 residue motif consisting of residue 123 to residue 136 of SEQ

ID NO:2 (PDKTGYTNTSIWVP), or, a 17 residue motif located at amino acid residue 123 to residue 139 of SEQ ID NO:2 (PDKTGYTNTSIWVPGEF);

(y) the composition of (v), wherein the non-cannulae polypeptide is inserted into the CanA polypeptide at the site a subsequence is removed; or

(z) the composition of (v), wherein the non-cannulae polypeptide is a 14 or a 17 residue motif inserted into the CanA polypeptide to replace a removed 14 or a 17 residue motif.

Claim 2 to 25 (canceled)

Claim 26 (currently amended): An immobilized composition ~~chimeric polypeptide~~ comprising the composition ~~chimeric polypeptide~~ of claim 1.

Claim 27 (currently amended): A tubule or nanotubule, bundle, ball, fiber, filament or sheet comprising

(a) a plurality of the compositions of ~~chimeric polypeptides as set forth in~~ claim 1;

(b) the tubule or nanotubule, bundle, ball, fiber, filament or sheet of (a), wherein the non-cannulae polypeptide comprises an enzyme or an enzyme co-factor;

(c) the tubule or nanotubule, bundle, ball, fiber, filament or sheet of (b), wherein the tubule or nanotubule, bundle, ball, fiber, filament or sheet comprises a plurality of different enzymes;

(d) the tubule or nanotubule, bundle, ball, fiber, filament or sheet of (c), wherein the plurality of enzymes comprises a biosynthetic pathway;

(e) the tubule or nanotubule, bundle, ball, fiber, filament or sheet of (c), wherein the plurality of enzymes are arranged along the length of the tubule or nanotubule, bundle, ball, fiber, filament or sheet in the same order as they act in the biosynthetic pathway;

(f) the tubule or nanotubule, bundle, ball, fiber, filament or sheet of any of (a) to (e), wherein the non-cannulae polypeptide comprises a chiral selection motif;

(g) the tubule or nanotubule, bundle, ball, fiber, filament or sheet of any of (a) to (f), wherein the non-cannulae polypeptide comprises a protein binding domain or small molecule binding domain; or,

(h) the tubule or nanotubule, bundle, ball, fiber, filament or sheet of (g), wherein the protein binding domain comprises a biotin.

Claims 28 to 34 (canceled)

Claim 35 (currently amended): A nucleic acid comprising a sequence encoding the composition chimeric polypeptide of claim 1, wherein the at least one additional domain comprises a polypeptide or peptide.

Claim 36 (currently amended): An expression cassette or vector comprising the nucleic acid of claim 35.

Claim 37 (currently amended): A cell comprising  
(a) the nucleic acid of claim 35, or the expression cassette or vector of claim 36; or  
(b) the cell of (a), wherein the cell is a bacterial cell, a plant cell, a yeast cell, a fungal cell, an insect cell or a mammalian cell.

Claim 38 (canceled)

Claim 39 (currently amended): A transgenic non-human animal comprising the nucleic acid of claim 35, or the expression cassette or vector of claim 36.

Claim 40 (currently amended): A plant or a seed comprising the nucleic acid of claim 35 or the composition chimeric polypeptide of claim 1, or the expression cassette or vector of claim 36.

Claim 41 (currently amended): A method for the chiral selection of a specie of a racemic mixture composition, comprising the following steps:  
(a) providing a composition of chimeric polypeptide as set forth in claim 6;  
(b) providing a racemic mixture of the composition; and,  
(c) contacting the racemic mixture with the composition chimeric polypeptide under conditions wherein only one enantiomer of the composition binds to the composition chimeric polypeptide; thereby selecting a single chiral specie of the racemic mixture.

Claim 42 (currently amended): A method for the chiral selection of a specie of a racemic mixture composition, comprising ~~the following steps~~:

- (a) providing the [[a]] tubule or nanotubule, bundle, ball, fiber, filament or sheet ~~of as set forth in claim 27~~;
- (b) providing the [[a]] racemic mixture ~~of the composition~~; and,
- (c) contacting the racemic mixture with the tubule or nanotubule, bundle, ball, fiber, filament or sheet under conditions wherein only one enantiomer of the composition binds to the tubule or nanotubule, bundle, ball, fiber, filament or sheet; thereby selecting a single chiral specie of the racemic mixture.

Claim 43 (currently amended): A method for enzymatic biosynthesis of a composition, comprising ~~the following steps~~:

- (A) (a) providing the [[a]] tubule or nanotubule, bundle, ball, fiber, filament or sheet comprising a plurality of enzymes comprising ~~of as set forth in~~ biosynthetic pathway ~~of as set forth in~~ claim 27;
  - (b) providing a substrate for at least one enzyme; and,
  - (c) contacting the tubule or nanotubule, bundle, ball, fiber, filament or sheet with the substrate under conditions wherein the enzymes of the biosynthetic pathway catalyze the synthesis of the composition;
- (B) the method of claim (A), wherein the enzymes are expressed in the inner lumen of the tubule or nanotubule, bundle, ball, fiber, filament or sheet; or
- (C) the method of claim (A), wherein the enzymes are expressed on the exterior of the tubule or nanotubule, bundle, ball, fiber, filament or sheet.

Claims 44 to 45 (canceled)

Claim 46 (currently amended): A cell comprising

- (a) the composition a chimeric protein of claim 1 or the [[a]] tubule or a tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27; or
- (b) the cell of (a), wherein the cell is a bacterial cell, a plant cell, a yeast cell, a fungal cell, an insect cell or a mammalian cell.

Claim 47 (canceled)

Claim 48 (currently amended): A transgenic non-human animal comprising the **[[a]]** chimeric protein of claim 1 or the **[[a]]** tubule or a nanotubule of as set forth in claim 27.

Claim 49 (currently amended): A plant or a seed comprising the **[[a]]** chimeric protein of claim 1 or the **[[a]]** tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27.

Claim 50 (currently amended): A fiber comprising the **[[a]]** tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27.

Claim 51 (currently amended): A fabric or textile comprising the **[[a]]** tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27.

Claim 52 (currently amended): A fabric, textile, sheet or covering comprising a fiber or a thread comprising the **[[a]]** tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27, wherein the tubule or nanotubule, bundle, ball, fiber, filament or sheet is woven into a fabric, textile, sheet or covering.

Claim 53 (currently amended): A product of manufacture comprising  
(a) the composition a chimeric protein of claim 1 or the **[[a]]** tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27, a non-derivatized cannulae protein, or a combination thereof;

(b) the product of manufacture of (a), comprising a computer, a transistor or a circuit comprising the chimeric protein;

(c) the product of manufacture of (a) or (b), comprising a sheeting, a covering, a coating or an adhesive comprising the chimeric protein; or

(c) the product of manufacture of any of (a) to (c), comprising a flame retardant or heat resistant device comprising a sheeting, a covering, a coating or an adhesive comprising the chimeric protein.

Claims 54 to 56 (canceled)

Claim 57 (currently amended): A medical device or an implant comprising the [[a]] chimeric protein of claim 1 or the [[a]] tubule or a tubule or nanotubule, bundle, ball, fiber, filament or sheet of ~~as set forth in~~ claim 27, a non-derivatized cannulae protein, or a combination thereof.

Claim 58 (currently amended): A method for polymerizing the [[a]] nanotubule, bundle, filament or sheet comprising mixing a plurality the composition of ~~chimeric proteins as set forth in~~ claim 1 in a solution comprising an iron sulfate, a manganese sulfate, a lead sulfate, a lithium sulfate, a manganese chloride or a calcium chloride or an equivalent salt, under conditions wherein the chimeric protein polymerizes into a nanotubule.

Claim 59 (currently amended): A fluorescent chimeric polypeptide comprising  
(a) at least a first domain comprising a cannulae polypeptide and a second domain comprising a heterologous polypeptide or peptide, wherein the heterologous polypeptide or peptide comprises a fluorescent moiety; or  
(b) the fluorescent chimeric polypeptide (a), wherein the fluorescent moiety comprises a green fluorescent protein or equivalent.

Claim 60 (canceled)

Claim 61 (currently amended): A fluorescent nanotubule, bundle, filament or sheet comprising the [[a]] fluorescent chimeric polypeptide of claim 59 [[60]].

Claim 62 (original): A bonding or adhesive composition comprising a microarray, filament, sheet, fabric or bundle comprising a plurality of chimeric proteins as set forth in claim 1.

Claim 63 (currently amended): A bonding or adhesive composition comprising a microarray, filament, sheet, fabric or bundle comprising a tubule or nanotubule, bundle, ball, fiber, filament or sheet of ~~as set forth in~~ claim 27.

Claim 64 (currently amended): A filter comprising a microarray, filament, sheet, fabric or bundle comprising a tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27.

Claim 65 (currently amended): A detecting device comprising a microarray, filament, sheet, fabric or bundle comprising a tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27.

Claim 66 (currently amended): A detoxifying device comprising a microarray, filament, sheet, fabric or bundle comprising a tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27.

Claim 67 (currently amended): A kit comprising a product of manufacture comprising the composition of a chimeric protein as set forth in claim 1 or a tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27, a non-derivatized cannulae protein, or a combination thereof, and instructions for using the product of manufacture.

Claim 68 (currently amended): A pharmaceutical composition comprising  
(A) (a) the composition of a chimeric protein as set forth in claim 1 or the [[a]] tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27;

(b) the pharmaceutical composition of (a), wherein the at least one additional domain is attached at the amino terminal end, the carboxy terminal end or internal to the cannulae polypeptide; or

(B) (a) a chimeric protein comprising at least a first domain comprising a cannulae polypeptide and at least a second domain comprising a heterologous domain;

(b) the pharmaceutical composition of (a), wherein the heterologous domain is attached at the amino terminal end, the carboxy terminal end or internal to the cannulae polypeptide;

(c) the pharmaceutical composition of (a) or (b), wherein the cannulae polypeptide comprises a protein having at least about 50%, 51%, 52%, 53%, 54%, 55%, 56%, 57%, 58%, 59%, 60%, 61%, 62%, 63%, 64%, 65%, 66%, 67%, 68%, 69%, 70%, 71%, 72%, 73%, 74%, 75%, 76%, 77%, 78%, 79%, 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, 90%,



91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% sequence identity to SEQ ID NO:2, SEQ ID NO:4, SEQ ID NO:6, SEQ ID NO:8, SEQ ID NO:10 or SEQ ID NO:12, or a FtsZ protein domain;

(d) the pharmaceutical composition any of (a) to (c), wherein the chimeric polypeptide comprises a recombinant fusion protein and the heterologous domain comprises polypeptide or a peptide; or

(e) the pharmaceutical composition of any of (a) to (d), wherein the heterologous domain of the chimeric polypeptide comprises an epitope, an immunogen, a toleragen, a carbohydrate binding domain, a cell matrix binding domain, a small molecule, a small molecule binding domain, a lipid, a carbohydrate, an enzyme, a cytokine or an antibody.

Claims 69 to 73 (canceled)

Claim 74 (currently amended): A vaccine comprising

(a) the composition of a chimeric polypeptide as set forth in claim 1 or the [[a]] tubule or nanotubule, bundle, ball, fiber, filament or sheet of as set forth in claim 27, and a pharmaceutically acceptable excipient;

(b) the vaccine of (a), wherein the at least one additional domain of the composition comprises an epitope, an immunogen, a toleragen, an immunomodulatory agent, an immune suppression agent, an adjuvant, an antibody, a cell binding agent, a carbohydrate or a combination thereof; or

(c) the vaccine of (a) or (b), wherein the chimeric polypeptide is assembled or self-assembles into a tubule or nanotubule, bundle, ball, fiber, filament or sheet.

Claims 75 to 76 (canceled)

Claim 77 (currently amended): A method for modulating the immune system of an individual comprising

(a) administering a pharmaceutically effective amount of the [[a]] composition of as set forth in claim 1, the [[a]] pharmaceutical composition of claim 68 or claim 69 or the [[a]] vaccine of as set forth in claim 74, to an individual in need thereof;

(b) the method of (a), wherein a humoral or a cell-based immune response is elicited in the individual; or

(c) the method of (a) or (b), wherein the individual is a human.

Claims 78 to 79 (canceled)

Claim 80 (currently amended): A carbohydrate-based therapeutic pharmaceutical composition comprising

(a) the [[a]] composition of ~~as set forth in~~ claim 1, or the [[a]] tubule or nanotubule, bundle, ball, fiber, filament, thread, or sheet of ~~as set forth in~~ claim 27, wherein the composition, tubule or nanotubule, bundle, ball, fiber, filament, thread, or sheet comprises at least one carbohydrate; or

(b) the carbohydrate-based therapeutic pharmaceutical composition of (a), wherein the composition, tubule or nanotubule, bundle, ball, fiber, filament, thread, or sheet comprises a polypeptide or peptide having a carbohydrate-binding motif;

(c) the carbohydrate-based therapeutic pharmaceutical composition of (a) or (b), wherein the carbohydrate-binding motif is an N-linked carbohydrate-binding motif or an O-linked carbohydrate-binding motif; or

(d) the carbohydrate-based therapeutic pharmaceutical composition of any of (a) to (c), wherein the carbohydrate is added chemically, by cellular biosynthetic mechanisms, by *in vitro* enzymatic reactions, or a combination thereof.

Claims 81 to 83 (canceled)

Claim 84 (currently amended): A method for ameliorating a disease or condition comprising

(a) administering a pharmaceutically effective amount of the [[a]] carbohydrate-based therapeutic pharmaceutical composition of claim 80 to an individual; or

(b) the method of (a), wherein ameliorating the disease or condition comprises inhibition of carbohydrate-lectin interactions; immunization with carbohydrate antigens; inhibition of enzymes that synthesize disease-associated carbohydrates; inhibition of carbohydrate-processing

enzymes; targeting of drugs to specific disease cells via carbohydrate–lectin interactions; administering carbohydrate based anti-thrombotic agents.

Claim 85 (canceled)

Claim 86 (currently amended): A cell matrix binding composition comprising  
(a) the [[a]] composition of ~~as set forth in~~ claim 1, or the [[a]] tubule or nanotubule, bundle, ball, fiber, filament, thread, or sheet of ~~as set forth in~~ claim 27, wherein the composition, tubule or nanotubule, bundle, ball, fiber, filament, thread, or sheet comprises at least one a cell matrix binding motif;

(b) the cell matrix binding composition of (a), wherein the cell matrix binding motif comprises an RGD-binding motif or an RGD motif;

(c) the cell matrix binding composition of (a) or (b), comprising a medical device; or

(d) the cell matrix binding composition of (c), wherein the medical device comprises a dental or orthopedic prostheses, a dental device or implant, an orthopedic device, a pin, a screw, a fixture, a plate, a stent, a stent sheath, a shunt, a catheter, a valve, a cannulae, a tissue scaffold, a wound care device, a dressing or a lens.

Claims 87 to 89 (canceled)

Claim 90 (currently amended): A tissue scaffold or implant material comprising  
(a) the [[a]] composition of ~~as set forth in~~ claim 1, or the [[a]] tubule or nanotubule, bundle, ball, fiber, filament, thread, or sheet of ~~as set forth in~~ claim 27;

(b) the tissue scaffold or implant material of (a), wherein the tissue scaffold comprises a polymer scaffold and neural stem cells for repairing a spinal cord injury;

(c) the tissue scaffold or implant material of (a) or (b), wherein the tissue scaffold comprises a vascular graft comprising graft material from smooth muscle, endothelial muscle and/or stem cells.

Claims 91 to 92 (canceled)

Claim 93 (currently amended): A cell or tissue transplant device or a cell or tissue implant device comprising

(a) the [[a]] composition of ~~as set forth in~~ claim 1, or the [[a]] tubule or nanotubule, bundle, ball, fiber, filament, thread, or sheet of ~~as set forth in~~ claim 27; or

(b) the cell or tissue transplant device or a cell or tissue implant device of (a), wherein the cells or tissues comprise nerve cells or tissues, skin cells or tissues, epidermal cells, dermal cells, liver cells or tissue; kidney cells or tissue; pancreatic cells or tissues; tubular structural cells, vascular elements, arteries, arterioles, veins, ureter cells or structure, bladder cells, urethral or structure, ductal tissue, bone cells or tissue, cartilage cells and/or muscle cells or tissue.

Claims 94 to 95 (canceled)

Claim 96 (currently amended): A bottle-brush polymeric protein structure comprising the composition a chimeric polypeptide of claim 1 and a FtsZ domain.

Claim 97 (currently amended): A chromatography resin comprising

(a) the composition a chimeric polypeptide of claim 1; or

(b) the composition a chimeric polypeptide of claim 1 and a FtsZ domain.

Claim 98 (canceled)